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## ***Interactive comment on* “Observations of water masses and circulation in the Eurasian Basin of the Arctic Ocean from the 1990s to the late 2000s” by B. Rudels et al.**

### **Anonymous Referee #2**

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Review of ‘Observations of water masses and circulation in the Eurasian Basin of the Arctic Ocean from the 1990s to the late 2000s’ by B. Rudels, U. Schauer, G. Björk, M. Korhonen, S. Pisarev, B. Rabe, and A. Wisotzki.

### General comments

The manuscript of Rudels et al. presents the results of oceanographic measurements obtained during several cruises to the Arctic Ocean conducted in the period between 1991 and 2007. A portion of the dataset originates from the Swedish icebreaker R/V Oden, (1991, 1996 and 2005 expeditions), yet the majority of the data were gathered by the German icebreaker R/V Polarstern (1996 cruise and the IPY 2007 SPACE ex-

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pedition). This valuable dataset is used for describing the Atlantic-origin water masses properties and their transformation during their advection through the Eurasian Basin.

Physical properties, geographical locations and mutual configuration of water masses serve speculative discussion concerning the possible Atlantic water circulation pathways and changes in the characteristics along the way as a result of numerous processes. The Fram Strait branch versus the Barents Sea branch of the Atlantic water inflows are analysed. Some brief paragraphs apply to thermohaline intrusions and also to the deep and bottom waters observed in the area of investigation. Furthermore, time variabilities, which occurred in the defined regions between 1991 and 2007, are described with references to other studies.

The geographical range of the CTD stations concentrate mostly on the Eurasian Basin, however, several sections cross the Lomonosov Ridge and the authors take into consideration the Amerasian Basin as well. Thus, the title of the manuscript may be somehow misleading.

The text is generally well written, its structure is clear. The topic of the manuscript follows the authors' ideas and findings concerning the role and impact of the Barents Sea branch on the Arctic Ocean water column. Special attention is also dedicated to the shelf-basin interactions issues.

Anyhow, divagations of the authors give the impression of being too long and perhaps too complex in certain places (particularly in Chapter 4).

The paper contains a lot of figures: sections, profiles,  $\theta$ S diagrams and maps. The graphics generated in the ODV software are good, even though sometimes they are hard to decipher. Nevertheless, the captions help to understand the authors' excursions.

Unfortunately, one important figure is missing, namely the Atlantic water circulation scheme in the Arctic Ocean and Nordic Seas. Even if it had been published before in

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the authors' previous publications and other papers, this image should be also included in the current paper which is a kind of the knowledge resume. Also the title of the paper obliges to present such a scheme.

Despite the several above-mentioned remarks, I find the reviewed manuscript meaningful. I believe that it is indeed a substantial contribution to the progress of the ocean science and it features good scientific quality presented in a sufficient way. Therefore, I suggest to publish it after only some minor modifications.

### Specific comments

Introduction is short but informative. Sections 2 and 3 give focused reviews of the knowledge development and recent findings concerning the Barents Sea branch (Section 2) and the Fram Strait branch (Section 3) of the Atlantic-origin water inflow. However, references in these sections are mostly auto-citations, which could be improved. Section 4 is the longest one and describes in detail hydrographical measurements (sections, profiles,  $\theta$ S diagrams). A lot of examples from various cruises, locations and periods confirm the main thesis of the manuscript – importance of the Barents Sea branch in maintaining the water column structure in the Arctic Ocean. Page 2703, line 22. 'Furthermore, the SPACE sections are reoccupations. . .' Only small parts of two SPACE sections are 'reoccupation'. Page 2704, line 7, 'The section along 30° E. . .' The section does not lie along the 30° E meridian. It seems to be rather 35° E (as shown in Fig 2a). Page 2705, line 26-28. 'while in years with no ice and warmer, more saline water over the bank the water column exhibited lower densities, also in comparison with 2007 (Quadfasel et al., 1992).' - there is a need to clarify the reason of using this citation.

Page 2710, line 2. 'The transport of the Fram Strait branch water in the boundary current would then be all but extinguished north of the Laptev Sea . . .' It is an essential conclusion and should be better documented or explained. The further explanation (9-19, page 2710) might be enriched here by including the circulation scheme.

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Section 5 describes the time variability of the Atlantic water temperature and salinity. Sections performed in 1991, 1996, 2001, 2005, 2007 from the Gakkel Ridge to the Makarov Basin are analysed. Changes of water properties are explained by the circulation. Again, adding the circulation scheme could make reading smoother.

What are the derived (postulated) mean advection velocities ?

Many details concerning the values which increase and decrease in specific regions collected in this section are difficult to distinguish. A table matching facts and estimations would make them easier to capture.

Section 6 applies to thermohaline intrusions. In this part figures are especially helpful. All the structures such as fronts or intrusions are evident on the  $\theta S$  diagrams. However, locations of profiles are not easy to distinguish.

Page 2713, line 18-19. 'The advective velocities are with great certainty larger than cross frontal velocities of the intrusions caused by double-diffusive convection'. A sort of estimation would be suitable again.

Section 7 is a complement to Section 4 and briefly describes deep and bottom water masses as well as formation processes. The part concerning the role of eddies in the transfer of the Barents Sea branch water is of particular interest.

Fig 18. There are more than 2 stations with increasing temperature and salinity near the bottom (blue, for instance). Are the two mentioned stations (green and magenta) somehow special?

Summary similarly as the Introduction is compact and informative.

Technical corrections Maps with indicated sections are difficult to decipher (the marks are not big enough). Likewise, on some sections plots numbers are simply invisible. Moreover, positions of particular stations on the map are difficult to read. Fitting to the individual region and decreasing the scale would be probably a better idea than limiting to the common range ( $0^\circ$  to  $150^\circ$  E,  $70^\circ$  to  $90^\circ$  N) even though it allows to trace

each section in the area step by step. Minor remarks and corrections Fig 3b, salinity – the color scale description is missing. Isohalines do not cover the whole range (in the southern part of the section). Page 2703 Line 4: “Orvik” instead of “Orvig”. The same in the references.

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